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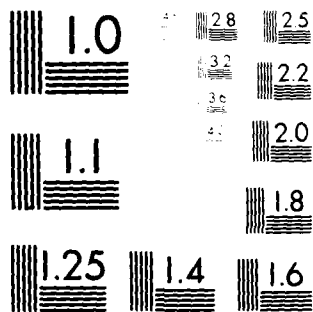
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Annual Summary Report

Activities of the Committee on Human Factors:

October 1, 1980-September 30, 1981

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Office of Naval Research  
Arlington, Virginia

US Army Research Institute for the Behavioral and Social Sciences  
Alexandria, Virginia

US Air Force Office of Scientific Research  
Bolling Air Force Base, District of Columbia

November 30, 1981

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these problems and the basic research needed to alleviate these problems;  
(b) establishing membership and guidelines for a special working group on simulation; (c) planning the conduct of a workshop on applied methodologies that will identify some methodologies suitable for presentation at a tutorial symposium and other methodologies deserving research support.

This report does not contain findings, conclusions or research recommendations. These will be contained in a technical report to be completed in 1982.

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Activities of the Committee on Human Factors:  
October 1, 1980-September 30, 1981

ABSTRACT

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Activities of the Committee on Human Factors:

October 1, 1980-September 30, 1981

INTRODUCTION

This report summarizes the significant activities and substantive issues of concern to the National Academy of Sciences-National Research Council's Committee on Human Factors (COHF) during the period October 1, 1980 and September 30, 1981. The committee's findings and recommendations on basic research issues in human factors are not included; these findings and recommendations will be the subject of a technical report to be issued in 1982, subsequent to review and approval by the Assembly of Behavioral and Social Sciences and the National Research Council.

BACKGROUND

National Academy of Sciences-National Research Council

The National Academy of Sciences was chartered in 1863 by the US Congress to be a honorary society of the nation's scientists which would function as an official adviser on matters of science and technology to the federal government. In 1916, the National Academy of Sciences organized the National Research Council (NRC) and, in 1918, made the NRC a permanent operating agency. Through the NRC, the National Academy of Sciences, and its sister organization, the National Academy of Engineering (formed in 1964), are able to draw on the nation's leading scientists, scholars, and other professionals to provide scientific and technical advice to the federal government.



Under the administration of NRC's eight assemblies and commissions, committees are formed to deal with specific questions or particular subject areas. These committees, constituted of scientists and engineers with relevant expertise, traditionally meet, gather information, and issue a report on their findings, conclusions, and recommendations.

#### Origins of the Committee on Human Factors

Since World War II, the demand has been increasing for applications of knowledge of human performance in a wide variety of situations; the interest in applications involving the relationship between behavior and technology has become notably intense. Human factors specialists, whether psychologists, physiologists or engineers, have been severely pressed when attempting to apply existing knowledge to the growing number of applied problems. Their capacity to cope with these problems has been limited by the relatively small amount of basic research performed to expand the knowledge base useful for human factors work.

Recognizing that this situation has serious consequences for the military services, the Office of Naval Research, the US Army Research Institute for the Behavioral and Social Sciences, and the US Air Force Office of Scientific Research decided to sponsor, within the NRC, a committee on human factors. This committee's concern is improvement of the scientific knowledge base of human factors work and promotion of other advancements in this field.

After the awarding of the contract, the Committee on Human Factors was established within the Assembly of Behavioral and Social Sciences, one of the eight major subdivisions of the NRC. Membership of the committee was established in accordance with NRC procedures; suggestions regarding the membership were sought from the committee sponsors as well as experts in the field. The Assembly of Behavioral and Social Sciences

approved Dr. Richard W. Pew as chairman and twelve other individuals as members of the committee. The names, principal areas of expertise, and organizational affiliations of the committee membership is given in table 1.

TABLE 1  
COMMITTEE ON HUMAN FACTORS  
Membership

Human Factors

Alphonse Chapanis, Johns Hopkins University  
Irwin L. Goldstein, University of Maryland  
J. C. R. Licklider, Massachusetts Institute of Technology  
Richard W. Pew, Bolt Beranek and Newman Inc. (CHAIRMAN)

Psychology

Nancy S. Anderson, University of Maryland  
Herschel W. Leibowitz, Pennsylvania State University  
Michael Posner, University of Oregon

Social Psychology

Jerome Singer, Uniformed Services University of the Health  
Sciences

Decision Research

Baruch Fischhoff, Decision Research (Perceptronic)

Sociology

Charles B. Perrow, Yale University

Anthropometry and Biomechanics

K. H. Eberhard Kroemer, Virginia Polytechnic Institute & State  
University

Engineering

Thomas B. Sheridan, Massachusetts Institute of Technology

Statistics

J. E. Keith Smith, University of Michigan

Concurrent with the establishment of the committee membership, a professional staff member and a secretary were hired as full-time employees of the NRC. Dr. Robert T. Hennessy and Ms. Karen A. English support the committee's activities as the committee's study director and administrative secretary, respectively.

The general purposes of the committee, expressed in the contract statement of work, are to:

- advise its sponsors regarding the most important basic research needs in the field as a whole and provide guidance on methods for investigating such problems;
- explore, in depth, the state of knowledge in selected areas judged to be of particular importance as a basis for the development of detailed research agendas in these areas;
- provide a mechanism for encouraging contact and communication among both basic and applied researchers in the field both in this country and abroad;
- attempt to interest outstanding younger scientists and senior persons outside the field of human factors engineering in conducting basic research relevant to major theoretical and methodological issues; and
- respond to requests from its sponsors for advice on specific problems or issues relating to their research programs.

#### COMMITTEE ACTIONS

##### Committee Meetings

The committee held four meetings between December 1980 and September 1981.

First meeting, December 2-3, 1980. The first meeting of the committee was held in the National Academy of Sciences Building,

Washington, DC. After welcoming remarks by the chairman, committee members introduced themselves and described their individual areas of scientific interest. Representatives from the sponsoring organizations briefly reviewed the variety of research supported by their respective organizations. They also stated their general expectations about the results of the committee's work: that research recommendations by the committee would help improve the scientific quality of DOD supported programs and the theoretical basis for applied human factors work.

During the remainder of the two day meeting, the committee formulated an agenda of topics and a work plan to be followed during the forthcoming year. The general actions the committee agreed to consider were: a) investigation of significant problems in human factors and the research necessary to alleviate these problems; b) initiation of a special working group on simulation; c) assessment of the status of human factors education and determination of appropriate actions for its improvement; and d) review of accident reporting procedures with the goal of improving such procedures.

A significant portion of the first meeting was devoted to discussing human factors problem topics. Consequently, a list of approximately twenty important topics was compiled. The strategy adopted by the committee was as follows: members would write a short essay on each topic which would describe the nature of the problem, and if possible, outline the kind of research which would be likely to lead to a solution of the problem.

Next, problems in simulation were considered important enough to warrant the attention of a special working group. The committee postponed an extended discussion of the working group until its February meeting.

In recognition of the increasing demand in both civilian and military organizations for competent human factors specialists, the committee expressed interest in addressing the status of human factors education. While the committee did not fully develop its intended course of action on this topic, it decided to: a) collect information about the number of institutions offering degrees in human factors and the nature of their respective curricula and b) establish contact with other relevant organizations to determine their interests and activities in human factors education.

The committee became interested in accident reporting procedures during a discussion of the topic of human error. Acknowledging the important relationship between competent accident analysis and the human factors aspects of the design of systems and equipment, the committee decided to examine the forms and procedures used in major accident reporting systems and see if useful recommendations to improve these systems could be made.

Finally, the committee agreed that visiting military installations with laboratories engaged in human factors research or applications would be beneficial. From these experiences, the committee expected to learn about issues of concern to human factors specialists working for the military and the problems encountered during the course of this work.

Second meeting, February 12-14, 1981. The second meeting was held in Orlando, Florida to permit the committee to visit the Visual Technology Research Simulator (VTRS) facility located at the Naval Training Equipment Center (NTEC). During this visit, the committee received briefings on the facility and training research being conducted at the VTRS and the NTEC Human Factors Laboratory. Table 2 summarizes the briefings received by the committee.

TABLE 2

Second Meeting of COHF  
Naval Training Equipment Center  
Orlando, Florida

BRIEFINGS

The VTRS: Physical Capabilities and Scope of Research  
Mr. Walter Chambers, Head, VTRS Branch  
Dr. Stanley C. Collyer, VTRS Behavioral Research Director  
Carrier Descent Rate Cuing  
Dr. Gavan Lintern, Canyon Research Group, Inc.  
Unconventional Displays for Flight Training  
Dr. Robert T. Hennessy, formerly of Canyon Research Group, Inc.  
Effects of Visual Factors on Carrier Landing and Research Methodology  
Dr. Daniel P. Westra, Canyon Research Group, Inc.  
Human Factors Research at NTEC  
Dr. Gilbert Ricard, Human Factors Laboratory

TOURS

The VTRS Facility - Mr. Chambers and Dr. Collyer

The committee spent two and a half days discussing its business agenda items. The majority of the time was devoted to discussion of the problem topics based on the essays prepared by the committee members. The outcome of these discussions was a slightly revised list of topics--with some new ones added, others dropped and still others combined.

A plan was formulated to complete a draft of the committee's first technical report in the fall of 1981. One outcome of this reorganization was a decision to devote particular attention to methodologies used in human factors work. Drawing a distinction between applied and experimental methodologies, the committee decided each was sufficiently important to deserve separate treatment.

The committee also decided that two aspects of problems related to methodology should be addressed: a) research to improve or advance

methodologies and b) the education of human factors specialists in various methodologies. At this time, the committee began to consider seriously the idea of holding tutorial workshops and symposia on methodologies.

During discussion of the simulation working group, the committee agreed to formulate general guidelines for the working group's efforts. However, the working group would be given the latitude to determine the specific problems to be addressed and the methods of approach to these problems. The committee also decided that the working group would limit its endeavors to simulation in which human operators or participants are involved. Consequently, the committee thought that simulation in terms of modeling of human performance should be considered separately--either by the committee or another working group.

Discussion of human factors education produced several possible courses of future committee action: a) continuing liaison with other organizations interested in human factors education; b) facilitating contact among military laboratories involved in human factors and local universities; and, c) developing a plan that can be used by universities and other institutions to establish human factors programs. No specific course of action was agreed upon and the topic was deferred for discussion at the next meeting.

Following up on its initial discussion of accident reporting systems, the committee considered a variety of problems related to obtaining reliable and useful data on accidents. Three committee members agreed to review accident reporting forms and procedures and discuss them at the next meeting.

Third meeting, May 7-9, 1981. The third meeting was held in Dayton, Ohio to enable the committee to hear briefings from personnel at the Air

Force Human Resources Laboratory and Air Force Aerospace Medical Research Laboratory and tour laboratory facilities at Wright-Patterson Air Force Base. A listing of the briefings and tours are given in table 3.

TABLE 3

Third Meeting of COHF  
Wright-Patterson AFB, Ohio

BRIEFINGS

Human Engineering Problems in NORAD  
Capt. Richard Poturalski  
C<sup>3</sup>Operator Performance Engineering (COPE)  
Capt. Richard Poturalski  
Crew, Group, Team and Unit Performance and Training  
Mr. Bertram Cream  
Tactical Aircraft Cockpit Development and Evaluation (TACDEP)  
Dr. Kenneth R. Boff  
COMBIMAN  
Dr. Joel McDaniel  
Workload Assessment  
Mr. Clark Shingledecker  
Strategic Avionics Crewstation Design Evaluation Facility(SACDEF)  
LTC John Brisby

TOURS

SACDEF-LTC John Brisby  
Visually Coupled Airborne Systems Simulator(VCASS)  
Mr. Dean Kocian  
COMBIMAN-Dr. Joel McDaniel  
Voice Actuated Control-Mr. Donald McKecknie  
Dynamic Environmental Simulator-Dr. Dana Rogers  
DIGISYN-Dr. John Reising

Most of the meeting time was devoted to discussion of the human factors problem topics and the selection of topics based on the essays, for inclusion in the committee's first technical report. The committee agreed to review the selected essays prior to the next meeting to expedite final approval of the draft of the technical report.

The discussion of applied methodologies resulted in the committee's decision to plan to hold workshops or symposia to acquaint human factors



specialists with a variety of important applied techniques. An essay on experimental methodologies identified three experimental techniques that are largely unknown to behavioral and human factors researchers. Recognizing the somewhat greater effort required to organize and plan workshops on experimental techniques, the committee agreed that it would be best: a) to gather more information on these techniques, and b) to speak to some of the principal experts about the application of these techniques to human factors. Definite plans to conduct a workshop on experimental methodologies were deferred to a later time.

The committee formulated a list of the nominees for the Working Group on Simulation and discussed guidelines for this working group. These guidelines would be drafted for review by the next meeting.

The committee decided to take no additional actions in human factors education beyond maintaining contact with other organizations. It also agreed that more substantial efforts in human factors education should be made once the initial technical report was completed.

The committee received a report from three of its members on the review of accident reporting forms and procedures. From this report and subsequent discussion, it was apparent that there is great potential for improving accident reporting forms and procedures. The three member sub-group agreed to prepare a short report summarizing their review and findings to present to the committee at the next meeting.

Interim activity. In June 1980, between the third and fourth meetings of the committee, the chairman and study director met with the sponsors' representatives to discuss the activities of the committee and future plans. At this meeting, all agreed that it would be useful to merge the problem topics under consideration by the committee into five or six major problem topic areas. Treating fewer but broader problem

topics was seen as a means for increasing the force of the committee's research recommendations and facilitating application of the collective wisdom and expertise of the committee.

At this June meeting, the committee's interest in applied methodologies both as topics for research recommendations and as subjects for tutorial symposia was also reviewed. There was general agreement that the committee should consider holding a short planning workshop involving participation of a small group of applied methodologies experts.

Members of the committee were notified of the results of this meeting.

Fourth meeting, September 25-26, 1981. The fourth meeting of the committee was held at the Joseph Henry Building of the National Academy of Sciences in Washington, DC. Representatives from the sponsoring military organizations attended as well as a representative from the National Aeronautics and Space Administration which would become a sponsor of the committee during fiscal year 1982. Sponsors' representatives briefly addressed the committee.

The chairman reviewed the discussion held earlier with the sponsors' representatives and initiated a discussion on the merits of having the committee address fewer but broader problem topic areas. After the committee agreed to this general course of action, the chairman presented an outline of six candidate topics for the committee to consider. Three of the topics were based on three essays already developed by committee members. Other previously drafted essay material was accordingly incorporated under the second three expanded topics. The tentative titles for the six new, expanded topics are: a) Relations between Organizational Factors and Human Factors; b) Behavioral Decision Theory; c) Eliciting Information from Experts; d) Human-Computer Interaction; e) Supervisory Control and Monitoring Behavior; and, f) Individual and

Group Variables in Human Factors. The committee adopted a work strategy of forming three sub-groups, each composed of those members of the committee whose expertise seemed most relevant to the topic.

Due to the additional work required to address the expanded topics, the committee developed a revised schedule of activities with the object of completing its initial report of findings and research recommendations by June 1, 1982.

The committee discussed surveying the service academies and other military schools to determine the status of human factors education at these institutions. The proposal to conduct a workshop on applied methodologies involving outside experts was also reviewed. The committee agreed that the workshop recommend specific methodologies to be presented at a tutorial symposium and other methodologies deserving research attention. Based on suggestions by various members, the committee approved a list of five outside experts to be invited to participate in the workshop.

The committee discussed the draft of a paper summarizing the review and analysis of accident reporting forms and procedures. Members agreed to send comments to the the authors. The committee will consider the disposition of this paper at its next meeting.

#### Additional Activities

In keeping with the committee's interests in promoting communication between basic and applied researchers, COHF agreed to co-sponsor with Naval Air Systems Command a one-day symposium on three-dimensional display research and applications to military systems. At this symposium, to be held in January 1982, researchers will present results of recent of studies on perceptual processes relevant to the use of 3D displays and discuss important issues for future research. Program

managers involved in the development of military control and display systems will discuss foreseen operational needs for 3D displays and application problems that will require research before such displays can be incorporated in operational systems.

At the request of the US Coast Guard, the committee has submitted a proposal to form a study panel to investigate the need for special flotation devices for the handicapped. The panel would determine if a need for these special devices exists and, if so, recommend a research plan for their development. The committee will have the responsibilities of overseeing the panel's activities and reviewing its report. However, these activities will require relatively minor effort and will not detract from the committee's ability to perform its principal tasks. If the study is funded, the panel will be formed early in 1982.

At its fourth meeting, the committee received a briefing from the Department of Energy, Office of Safeguards and Security, on security problems which appear to be related to human factors. The committee was asked to express its opinion about the necessary research required. However, it was apparent that the problems described, while behaviorally oriented, are peripheral to the field of human factors. The committee therefore declined to comment on research needs but suggested, by letter, the range of expertise necessary for a group which could adequately evaluate the research needs of the Office of Safeguards and Security.

#### SUMMARY OF PRINCIPAL WORK PERFORMED

The following is a summary of the committee's work on the three principal subjects it is addressing: critical research needs, simulation and human factors education. In some instances, notably in human factors education, the summary includes some amplification of developments that could not be conveniently incorporated in the chronological discussion of the committee's meetings and activities.

### Critical Research Needs

The principal task of the committee is to identify critical problems in human factors and recommend basic research which will lead to solutions of these problems. As a general working guideline, the committee agreed that problems they would consider should be generic ones, which occur across a broad spectrum of human interaction with technology, and be relevant to the concerns of the armed services. Moreover, these problems should be issues likely to be of increasing future concern--occurring because of the lack of data, principles, organizing theoretical structure, or adequate methodologies in the knowledge base of the disciplines used in applied human factors work.

Initially, the committee developed a list of approximately twenty problem topics which appeared worthy of consideration. Individual members wrote short essays on these problems which served as a basis for further discussion by the whole committee.

At subsequent meetings, the list of problem topics was revised--some topics being dropped, some, added, and others, combined. By the third meeting, the list had been reduced to approximately fifteen topics. Recognizing the importance of bringing the collective wisdom, expertise and judgment of the committee to bear on the problem topics and research recommendations, the committee agreed that the essay material already written should be restructured into fewer, broader topic areas.

Three sub-groups within the committee are addressing these topics. Additional work will be required to integrate the information contained in the existing essays and to generate other material to complete work on the expanded problem topics; restructuring of the problem topics and the required additional work meant, therefore, foregoing the September target

date for completion of a draft of the technical report. Consequently, the committee has set June 1982 as the target date for completion of its initial report of findings, conclusions, and basic research recommendations.

#### Simulation

At its first meeting, the committee agreed that simulation was a problem area of sufficient importance to deserve the attention of a special working group. Simulation is considered an important topic because of the significant financial and personnel resources being invested in it and because the use of simulation, particularly within the armed services, for training and system development is increasing.

The committee has made a distinction between simulation involving the participation of humans and simulation as performance modeling. These two categories of simulation, however, are substantially interrelated. As a practical matter, the committee has agreed that the initial working group should focus attention on simulation involving human participation for purposes of training, system design, and performance measurement.

The committee has agreed that the general goal of the working group will be to assess uses of simulation, to outline the problems common to a variety of simulator applications, and to recommend fundamental research beneficial to a wide variety of current and potential users of simulation. The committee projects that, once the working group completes its report on simulation involving human participation, another working group will address human performance modeling. At its September 1981 meeting, the committee approved a final list of nominees and alternates for the working group which is expected to begin work late in 1981 and complete a draft report by September 1982.

## Human Factors Education

Recognizing the influential nature of NRC committees, the members agreed that one of its principal goals should be the improvement of human factors education. The committee considered several options for achieving this goal. These are: affording educational opportunities for students entering the human factors field versus improving the continued education of human factors specialists; addressing the educational needs within both the civilian and military communities versus concentrating on the needs of the military sector; and attempting to influence educational policy versus directly sponsoring specific educational activities.

The committee initially considered devising a plan to assist universities and colleges in establishing human factors programs. As a first step, it reviewed material describing human factors programs in American educational institutions and recommendations for human factors curricula. The committee also took steps to establish liaison with other organizations interested in furthering human factors education. As part of its discussion of assisting the establishment of human factors programs, the committee also considered means for augmenting or aiding support of this plan at the federal level. For example, the committee considered ways of influencing military research agencies, as well as other government agencies, which fund research, to support educational institutions with grants and to provide students with fellowships.

Before committing itself to the considerable time and effort these endeavors would require, the committee considered other, less ambitious options for improving human factors education. Because the armed services sponsor COHF and employ a relatively large number of uniformed and civilian human factors specialists, the initial and continued education of these individuals is of particular concern to the

committee. To address the educational needs of uniformed personnel, the committee decided to obtain information from the service academies and post-graduate schools on courses devoted to or containing components of human factors principles and methods. After obtaining this information, the committee will decide the appropriateness and nature of some course of action. While the committee might take steps to improve human factors education at the service academies and other military schools, it also discussed the possibility of improving continued education for military human factors specialists by facilitating contact between these specialists and educational institutions in the vicinity of military installations. Another possibility under consideration is encouraging the cognizant military commands to support participation in meetings relevant to their interests and expertise.

The committee also considered sponsoring tutorial symposia as a means of improving human factors education. The committee's treatment of applied and experimental methodologies as problem topics expressed a concern for the lack of opportunities for human factors specialists to learn of existing methodologies that may be useful for their work. After weighing all of these various options, the committee decided to hold a workshop of selected experts to recommend methodologies that would be suitable topics for a tutorial symposium and others that deserve research attention.

In the immediate future, the committee will concentrate its efforts to improve human factors education on the planning of a tutorial symposium and reconsider other educational options after reaching its primary goal: a report of findings and recommendations on actual human factors problems and research necessary to alleviate these problems.



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